

CLAIMS

1. A foundation for a tower, comprising a plurality of prefabricated concrete shelters (12, 15, 16, 17, 18), each suitable for housing indoor equipment of a telecom network or the like, said shelters (12, 15, 16, 17, 18) being arranged on site such that every shelter is abutting and coupled to at least one other adjacent shelter, such that a substantially vertical surface (50) of contact exists there between, across which the means (70, 84, 94) of said coupling is transversely effected, resultantly all said shelters (12, 15, 16, 17, 18) are mechanically attached together and function as a monolithic foundation.

2. The foundation according to claim 1, wherein the plan view shape of said foundation is substantially a regular geometric shape, which is characterized by a polar symmetry about a central vertical axis.

3. The foundation according to claim 2, wherein said shelters (12, 15, 16, 17, 18) are all identical and are accordingly arranged around said common central vertical axis of polar symmetry.

4. The foundation according to any of claims 1 to 3, wherein each of said shelters (12, 15, 16, 17, 18) includes certain apparatus for anchoring part of tower-base, located on its roof, such that said anchoring apparatus of the entirely assembled foundation is geometrically fit and mechanically adequate to receive the base of said tower (20), either directly or through an interfacing tower-base structure.

5. The foundation according to claim 4, wherein said anchoring apparatus comprises vertical elongated threaded metal elements of any desired type, known in the art as "Anchor Bolts", embedded at least into the concrete roof of said respective shelter, but preferably down into said roof's supporting concrete wall (48, 49), as well.

6. The foundation according to any of claims 1 to 5, wherein the plan view shapes of said shelters (12, 15, 16, 17, 18) are such that, when all said shelters comprising a single foundation are assembled together, they encircle a substantially vertical internal shaft (60, 61, 62, 63, 64), through which antenna cables and other utility cables or pipes may be routed from near the base of said

tower (20) into each of said shelters (12, 15, 16, 17, 18).

7. The foundation according to claim 6, wherein an opening (66) or a plurality of openings, of any desired shape or size, for easy and neat routing of said antenna cables and other utility cables or pipes through the shelter's wall, are provided in desired locations in the walls defining said shaft (60, 61, 62, 63, 64), each of said openings preferably being fit to receive any desired type of known in the art cable-entry sealing systems.

8. The foundation according to any of claims 1 to 7, wherein said means of said coupling any two adjacent shelters (12, 15, 16, 17, 18) comprises:

A single or plurality of substantially horizontal bores (72), passing substantially transversely through the abutting walls of said two adjacent shelters, such that substantial bore (72) alignment exists when both shelters are finally positioned and are ready for being coupled,

and

A single or plurality of substantially horizontal elongated connecting members (70) passing through said bores.

9. The foundation according to claim 8, wherein said substantially horizontal bores (72) include lining sleeves (83).

10. The foundation according to any of claims 8 or 9, wherein said substantially horizontal elongated connecting members (70) comprise bolts (74) of appropriate size and length, each bolt (74) including a respective end tightening assembly comprising a single nut or a plurality of nuts (75) and, optionally, respective plate-washers.

11. The foundation according to any of claims 8 or 9, wherein said substantially horizontal elongated connecting members (70) comprise rods, each rod being threaded at both its ends in same direction, or alternatively threaded throughout its length, and including at each of both its ends a respective end tightening assembly, comprising a single nut (85) or a plurality of nuts (85) and, optionally, respective plate-washers (86).

12. The foundation according to any of claims 10 or 11, wherein each, or any selected part, of said substantially horizontal bores (72) includes a recess at its end facing the interior of the shelter, of any desired shape yet large enough to

house said respective end tightening assembly of said elongated connecting member, such that in the tightened coupling state, no part of the elongated connecting member (94) is projecting inwards from the internal surface of the respective wall.

5 **13.** The foundation according to claim 12, wherein said recess (90, 91) is made by a metal liner (92, 93) embedded in the concrete wall casting, said liner (92, 93) including a substantially vertical plate (97, 98), at least the size of the cross-section of said recess, with a hole substantially co-axial with said bore, said vertical plate being located in the border plane between said recess and said bore,
10 so as to provide a support surface against which said end tightening assembly of said elongated connecting member abuts when tightened.

14. The foundation according to claim 13, wherein said metal liner (92, 93) of said recess (90, 91) further includes apparatus for distribution of the concentrated load, caused by tightening of said elongated connecting member,
15 over an increased area of the concrete wall, said apparatus comprising either an enlargement of said vertical plate in excess of the cross-sectional dimensions of said recess, or a separate single or plurality of metal plates or bars welded to the exterior of said metal recess liner.

15. The foundation according to any of claims 1 to 14, wherein said
20 substantially vertical surface (50) of contact between any two adjacent shelters (12, 15, 16, 17, 18) comprises a substantially vertical plane having a bulge (52) or a plurality of bulges (52), of any desired shape and size, each of said bulges being defined by a protrusion formed on one of the two abutting walls (49) of said two adjacent shelters (12, 15, 16, 17, 18), and a socket of a matching shape, size and
25 location formed in the second of said two abutting walls, all said protrusions (54) and sockets (56) being provided so as to interlock with each other and thereby ensure that, in the assembled and coupled foundation, no relative vertical, lateral or rotational movement may occur in-between any two adjacent shelters in the foundation assembly.

30 **16.** The foundation according to claim 15, wherein any desired part of the surfaces of said protrusions (54), and optionally of said sockets as well, is provided with a liner made of a more durable material than the shelter's concrete, so as to

ensure that the shape of said protrusions (54) and sockets (56) may not be damaged due to any likely mechanical impact during any handling operation of the shelter, such as loading for transportation, off-loading or bringing to final position on site.

5 17. The foundation according to claim 15, wherein said protrusion/s (54) and said matching socket/s (56) are sized such that, when they fully interlock and resultantly the respective adjacent shelters (12, 15, 16, 17, 18) may not be brought any closer to each other, a relatively thin clearance remains in between the substantially planar parts of the two abutting wall surfaces; said clearance may
10 be left free or alternatively filled with cement based grout, or any other suitable material of no structural role, after final tightening of the means for coupling the shelters (12, 15, 16, 17, 18).

 18. A method of constructing a foundation for a tower, said method including:

15 Preparing prefabricated components of said foundation, comprising:

 A plurality of prefabricated concrete shelters, suitable for housing indoor equipment of a telecom network or the like, shaped such that, when arranged on site, every shelter is abutting at least one other adjacent shelter, with a substantially vertical surface of contact there between, and provided with certain
20 means for coupling every two adjacent shelters transversely through said substantially vertical surface of contact there between,
and

 Sufficient respective number of elongated connecting members, which are the non-integral parts of said means for coupling every two adjacent shelters;

25 Executing site preparation works in designated site area, including:

 Removal of any vegetation, including its roots, from the site area,
and

 Leveling and compacting the designated foundation area to a best feasible degree, so as to form a planar and horizontal support surface, moderately higher
30 than the surrounding ground level, using for this purpose either soil material naturally available on site (only if found suitable), or imported gravel, crushed stone or sand, or a layer of lean or normal concrete;

Placing said prefabricated concrete shelters in their final designated positions in a sequential order, and effecting and tightening said means of transversely coupling the shelters in the same sequential order, such that:

When the second of every two adjacent shelters is positioned, said means for transversely coupling said two shelters are all aligned, and said two shelters cannot be brought any closer to each other,
and

Said means for transversely coupling said two shelters being all finally tightened immediately after positioning said second of the two adjacent shelters, and before proceeding with placing any additional shelters of the foundation,
and

The last shelter of the foundation, if abutting more than one adjacent shelter, is brought to its final position exercising simultaneous alignment with all said adjacent shelters, and simultaneously effecting and tightening said means of coupling it to all said adjacent shelters.

19. The method according to claim 18, said site preparation works further including, as a first step, excavating and removing a certain thickness of the natural soil underneath the foundation and in a certain excess area there around, down to a depth where the load bearing capacity of the natural soil is found adequate, and backfilling with an improved quality soil or base material such as gravel, crushed stone or sand.

20. The foundation according to any of claims 1 to 17, further including a foundation enhancement assembly (100), placed underneath the assembly of said shelters, the two assemblies being fastened to each other by appropriate means of vertical fastening, said foundation enhancement assembly comprising:

A plurality of equi-high prefabricated concrete foundation elements (102), each having the shape of a box open at its top, said foundation elements (102) being arranged on site such that every foundation element (102) is abutting and coupled to at least one other adjacent foundation element (102), such that a substantially vertical surface of contact exists there between, across which the means of said coupling is transversely effected, resultantly all said foundation elements (102) are mechanically attached together and function as a monolithic

foundation.

21. The foundation according to claim 20, wherein said foundation enhancement assembly further includes an outwardly horizontal projection of its floor (112) from its perimeter walls, all along its perimeter or along any part thereof, so as to increase the contact area between the bottom surface of said foundation enhancement assembly and the underlying supporting surface.

22. The foundation according to any of claims 20 or 21, wherein said means of said transversely coupling every two adjacent foundation elements (102) is substantially the same as said means of said transversely coupling every two adjacent shelters.

23. The foundation according to any of claims 20 to 22, wherein said substantially vertical surface of contact in-between every two adjacent foundation elements (102) includes a bulge or a plurality of bulges, defined by protrusion/s and matching socket/s, having similar properties and fulfilling the same role as the protrusion/s (116) and matching socket/s (118) on the abutting surfaces of the walls of said shelters.

24. The foundation according to any of claims 20 to 23, wherein said appropriate means for vertical fastening of said assembly of shelters (12, 15, 16, 17, 18) down to said assembly of foundation elements (102) comprises:

A plurality of internally threaded metal devices, known in the art as "prefabricated concrete inserts", embedded vertically in the top surfaces of the walls of said foundation elements (102),
and

A plurality of vertical bores (144) in the floor of each shelter, located so as to be aligned, in the final positioning, with and above said internally threaded devices,
and

A plurality of elongated vertical fastening members, each having a threaded bottom portion matching the thread of said internally threaded devices, sized so as to be inserted into one of said vertical bores and thereby secure the floor of a respective shelter down to the top of a wall of an underlying foundation element.

25. The foundation according to claim 24, wherein said elongated vertical fastening members (150) comprise bolts of appropriate size and length and,

optionally, a respective plate-washer.

26. The foundation according to claim 24, wherein said elongated vertical fastening members (150) comprise rods, each rod being threaded at both its ends in same direction, or alternatively threaded throughout its length, and including at its top end, a respective end tightening assembly, comprising a single nut or a plurality of nuts and, optionally, a respective plate-washer.

27. The foundation according to any of claims 24 to 26, wherein each, or any selected part, of said vertical bores (144) in the shelters' (12) floors includes a recess at its top end, having same shape and size as the recesses in the ends of said substantially horizontal bores (122) in the shelters' walls, or any different desired shape or size, fulfilling the same role as that of said recesses (142) in the ends of said substantially horizontal bores in the shelters' walls, and made according to any preferred embodiment thereof.

28. The method according to claim 18, the prepared prefabricated components further comprising:

A plurality of equi-high prefabricated concrete foundation elements, shaped as boxes open at their tops and such that, when arranged on site, every foundation element is abutting at least one other adjacent foundation element, with a substantially vertical surface of contact there between, and provided with certain means for coupling every two adjacent foundation elements transversely through said substantially vertical surface of contact there between, and further provided with other means of vertical fastening between said shelters and said foundation elements,

and

A sufficient respective number of elongated connecting members, which are the non-integral parts of said means for coupling every two adjacent foundation elements,

and

A sufficient respective number of elongated vertical fastening members, which are the non-integral parts of said means for vertical fastening between said shelters and said foundation elements;

and

The site preparation works further including, as a first step, excavating the designated foundation area to a depth substantially equal to the height of each of said foundation elements, at which depth said leveling and compacting the designated foundation area is performed;

5 and

Placing of said prefabricated concrete shelters is preceded by:

Placing all said foundation elements in a sequential order and coupling them altogether in the same method as described for placing said shelters,
and

10 Backfilling the excavation around the placed and coupled foundation elements, preferably in individual layers such that appropriate compaction is applied to each layer before the material of following layer is backfilled,
and

15 Filling up the entire capacity within each of said foundation elements, as well as (if applicable) of the cavity encircled thereby, with local soil or with imported soil or granular material or sand.

20 **29.** The method according to claim 28, said site preparation works further including, as a second step, excavating and removing a certain additional thickness of the natural soil underneath the foundation and in a certain excess area there around, down to a depth where the load bearing capacity of the natural soil is found adequate, and backfilling up to a depth designated as the base level of said foundation elements with an improved quality soil or base material such as gravel, crushed stone or sand.